NOAA NESDIS
CENTRAL SATELLITE DATA PROCESSING CENTER

Advanced Microwave Sounding Unit-A (AMSU-A) Level 1b Format Differences

Version 1.1

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Table of Contents

1 Purpose

This document lists the modifications made to the current AMSU-A 1b format, referred to as the "NOAA-KLM 1b format", to create the new 1b format, referred to as the "NOAA-N/Metop 1b format", to be implemented for the launch of NOAA-N. Therefore, it essentially identifies the differences between these two formats. When implemented, the new NOAA-N/Metop 1b format will be applicable to all 1b data sets produced from the NOAA-KLMNN' and Metop satellites. This document also identifies those modifications to the previous release of the NOAA-N/Metop AMSU-A 1b format (dated June 13, 2003) that were made as part of the creation of this new 1b format. These modifications are specified in *italic* type.

2 Documentation Updates

- Added indications of fields that are applicable to just NOAA or just Metop.
- Added indications of fields that are applicable to just NOAA-KLM or just NOAA-NN'/Metop (usually shown in this document as "NOAA-N/Metop").
- Added Metop and NOAA-NN' spacecraft IDs in "Spacecraft Identification Code" field (byte offset 73-74) in header record. Renamed this field from "NOAA Spacecraft Identification Code" since Metop IDs are now included.
- Updated values for "Instrument ID" field in header record (byte offset 75-76) to include the instrument IDs of the NOAA-NN' and Metop-1/-2 satellites. Also, to simplify the definition of this field, it was changed from a single, 2-byte unsigned integer to a 2-element array of 1-byte unsigned integers. Element (word) 1 is the A2 ID and element 2 is the A1 ID. Note that this new definition is identical to the original where the high-order byte was the A2 ID and the low-order byte was the A1 ID.
- Updated values for "Data Source" field in header record (byte offset 171-172) to include new source of data (e.g., Svalbard).
- The 4-byte data record field "Scan Line Quality Flags" (bytes 29-32) was split into four separate 1-byte fields. Only the way this field has been organized and documented in the format has changed. Its content and the location of each of its individual flags remain unchanged. The four "new" fields are
    - "Scan Line Quality Flags [<Reserved>] (zero fill)" (byte 29),
    - "Scan Line Quality Flags [Time Problem Code]" (byte 30),
    - "Scan Line Quality Flags [Calibration Problem Code]" (byte 31), and
    - "Scan Line Quality Flags [Earth Location Problem Code]" (byte 32).

3 Header Record Modifications

- *Defined new field, "Offset between Start of Scan and Center of First FOV", in bytes 109-110. (These were spare bytes.) It is a single two-byte integer, and is the time, in milliseconds, between the start of the scan and the center of the scan's first FOV. It is included to aid a user in converting a 1b's scan line time back to the value as originally reported by the spacecraft.*
- The name and meaning of the field "Count of Data Frames Without Frame Sync Word Errors" (byte offset 153-154) was changed in order to match the way the field is actually being set, and to be consistent with its definition for other instruments (e.g., HIRS and AVHRR). The field was originally named "Count of AMSU Frames without Frame Sync Word Errors".

- Defined bits 0 and 1, which were previously undefined (zero fill), of "Earth Location Error Code" field (byte offset 167-168):
  - bit 1: "not earth located because of satellite in-plane maneuver (Metop) or <zero fill> (NOAA)"
  - bit 0: "not earth located because of satellite out-of-plane maneuver (Metop) or <zero fill> (NOAA)"
- *Changed bit 0 of the "Earth Location Bit Field" (byte offset 891-892) from "attitude error correction (0=not corrected; 1=corrected)" to "constant attitude error correction (0=not performed; 1=performed)". Defined bit 2, which was previously undefined, as "dynamic attitude error correction (0=not performed; 1=performed)".*
- The following fields, related to the new lunar contamination correction algorithm, were added in the filler area at the end of the header record:
  - "Count of Scans Containing Lunar-Contaminated Space Views" (byte offset 2357-2358).
  - "Distance Between the Earth and Moon" (byte offset 2359-2360).
  - "Angle Between the Moon and Sun" (byte offset 2361-2362).
- *Changed the scale factor of the header field "Distance Between the Earth and Moon" (byte offset 2359-2360) from 1 to 2.*
- *The following fields, related to Metop maneuvers, were added in the filler area at the end of the header record:*
  - *"Start of Maneuver Year" (byte offset 2365-2366).*
  - *"Start of Maneuver Day of Year" (byte offset 2367-2368).*
  - *"Start of Maneuver UTC Time of Day" (byte offset 2369-2372).*
  - *"End of Maneuver Year" (byte offset 2373-2374).*
  - *"End of Maneuver Day of Year" (byte offset 2375-2376).*
  - *"End of Maneuver UTC Time of Day" (byte offset 2377-2380).*
  - *"Change in Spacecraft Velocity" (byte offset 2381-2392).*
  - *"Spacecraft Mass" (byte offset 2393-2400).*

4 Data Record Modifications

- The following set of modifications were made because of changes in the AMSU-A data stream:
  - Updated meaning of word 16 of "Temperature Sensor Telemetry" (byte offset 1985-2076) to "<unused> (s/n 105-109); PLLO (reference oscillator) (s/n 101-104)". (Used to be "PLLO (reference oscillator)".)
  - Updated meaning of word 16 of "A1 Analog Telemetry" field (byte offset 2153-2180) to "+10 VDC receiver mixer/IF (s/n 105-109); +8.5 VDC phase lock loop ch. 9/14 (s/n 101-104)". (Used to be "+8.5 VDC phase lock loop ch. 9/14".)
  - Updated meaning of bit 16 of "Analog Telemetry Update Flags" (old "Invalid Word Bit Flags") (byte offset 2149-2152) to "bit 16: +10 VDC receiver mixer/IF; +8.5 VDC phase lock loop ch. 9/14". (Used to be "+8.5 VDC phase lock loop ch. 9/14".)
  - Updated meaning of word 11 of "A2 Analog Telemetry" (byte offset 2513-2528) to "+10 VDC (receiver/mixer/IF) (s/n 105-109); +8 VDC (receiver) (s/n 101-104)". (Used to be "+8 VDC (receiver)".)

- Updated meaning of bit 11 of "Analog Telemetry Update Flags" (old "Invalid Data Bit Flags") (byte offset 2509-2512) to "bit 11: +10 VDC (receiver/mixer/IF) (s/n 105-109); +8 VDC (receiver) (s/n 101-104)". (Used to be "+8 VDC (receiver)".)

- The following modifications, related to the new lunar contamination correction algorithm, were made (NOTE: all changes were made to spare or filler areas of the data record):
  - Defined bits 7 and 6, which were previously undefined (zero fill), of each word of "Calibration Quality Flags" (byte offset 33-64) as follows:
    - bit 7: "lunar contamination was detected in the space view of this channel"
    - bit 6: "the space views of this channel were corrected for lunar contamination when used in the calibration (only applicable if the previous flag [bit 7] is 1; otherwise, zero)"
  - Added the field "Space View Count Corrections" (byte offsets 2529-2543).
  - Added the field "Lunar Azimuth Angles" (byte offsets 2545-2550).
  - Added the field "Lunar Elevation Angles" (byte offsets 2551-2556).
- Unused (reserved) byte of the "Scan Line Quality Flags" field (byte offset 29) changed to contain additional calibration problem indicators (now named "Scan Line Quality Flags [Additional Calibration Problem Code]"). Defined bit 7 to indicate if the "scan line was not calibrated because of satellite maneuver (Metop) or <zero fill> (NOAA)".
- Defined bits 0 and 1, which were previously undefined (zero fill), of "Scan Line Quality Flags [Earth Location Problem Code]" field (byte offset 32):
  - bit 1: "not earth located because of satellite in-plane maneuver (Metop) or <zero fill> (NOAA)"
  - bit 0: "not earth located because of satellite out-of-plane maneuver (Metop) or <zero fill> (NOAA)"
- Defined bit 8, which was previously undefined (zero fill), of each word in the "Calibration Quality Flags" field (byte offset 33-64). Its definition is "this scan line is either the last one before or the first one after a sudden, anomalous jump (or drop) in calibration counts".
- *Added the following two new navigation-related field. They are located in what were spare bytes. The preceding spare (zero fill) field decreased in size from 16 bytes (bytes 441-456) to four bytes (bytes 441-444) to accommodate these new fields.*
  - *"Computed Yaw Steering" (bytes 445-450)*
  - *"Total Applied Attitude Correction" (bytes 451-456)*
- *Defined the following bits, which were previously undefined (zero fill), of "Navigation Status Bit Field" (bytes 457-460):*
  - *bits 20-19: "yaw steering parameters usage indicator"*
  - *bit 18: "Metop maneuver indicator"*
  - *bit 17: "earth location at the satellite subpoint is accurate and reasonable"*
- *For consistency and clarity, references to "Local azimuth angle" in the "Angular Relationships" field (byte offset 473-652) changed to "~~Satellite~~ Relative azimuth angle".*

per JD Stroup 1/24/05

- The meaning of the bits 9-12 of the fields "Digital B Telemetry for AMSU-A1" (byte offset 2143-2144) and "Digital B Telemetry for AMSU-A2" (byte offset 2503-2504) has changed when they are all zero. According to KLM documentation, when these bits are zero, the instrument is in the warm calibration position. For NOAA-N and the IJPS era, when all of these bits are zero, the AMSU-A instrument is operating in no mode. Digital A telemetry, analog telemetry, and bits 3 (A1 only), 13, and 14 of the digital B telemetry should be ignored.